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Anderson et al.

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(54) **DATA TRANSFER APPARATUS**

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(22) Filed: **Jan. 29, 2009**

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(51) **Int. Cl.**

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G11B 15/43	(2006.01)
G11B 15/62	(2006.01)

(52) **U.S. Cl.**

CPC ***G11B 15/43*** (2013.01); ***G11B 15/62*** (2013.01)

(58) **Field of Classification Search**

USPC 360/77.12, 75, 69, 55

See application file for complete search history.

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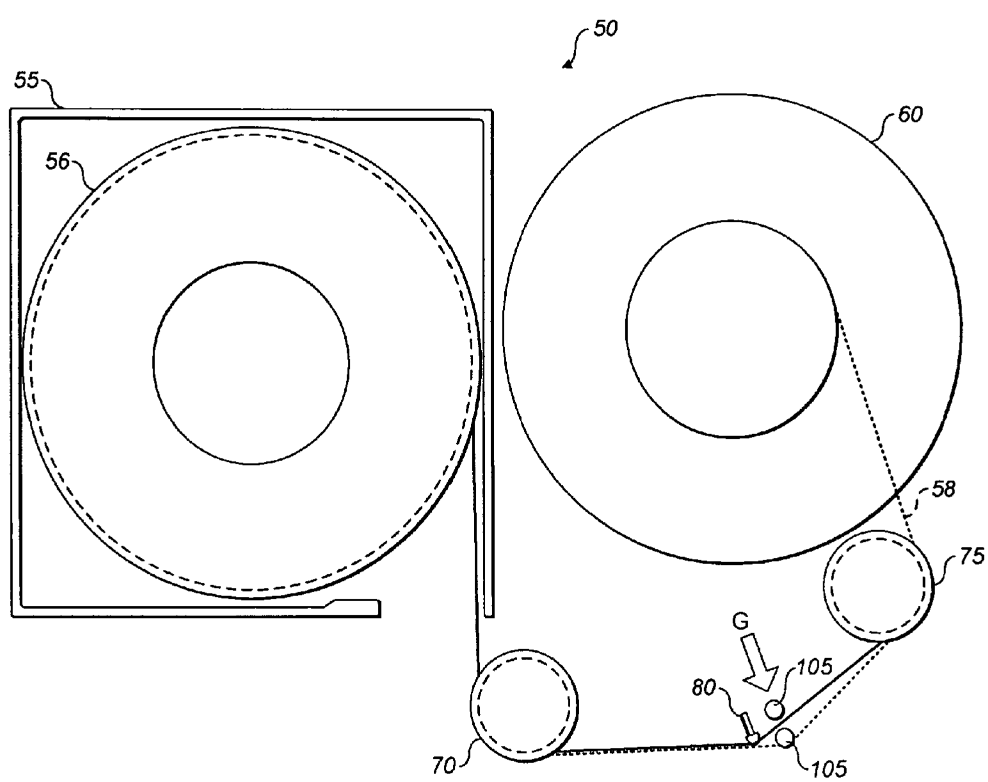
(57) **ABSTRACT**

A data transfer apparatus comprises drive apparatus to move a received tape along a path in a longitudinal direction of the tape, a transducer head to transfer data to and/or from the tape, a tape lifter to contact the tape; and control apparatus operable, in response to a tape speed related condition or event, to cause relative movement between the tape lifter and the tape into mutual contact, thereby biasing the tape away from surface to surface contact with the transducer head.

20 Claims, 8 Drawing Sheets



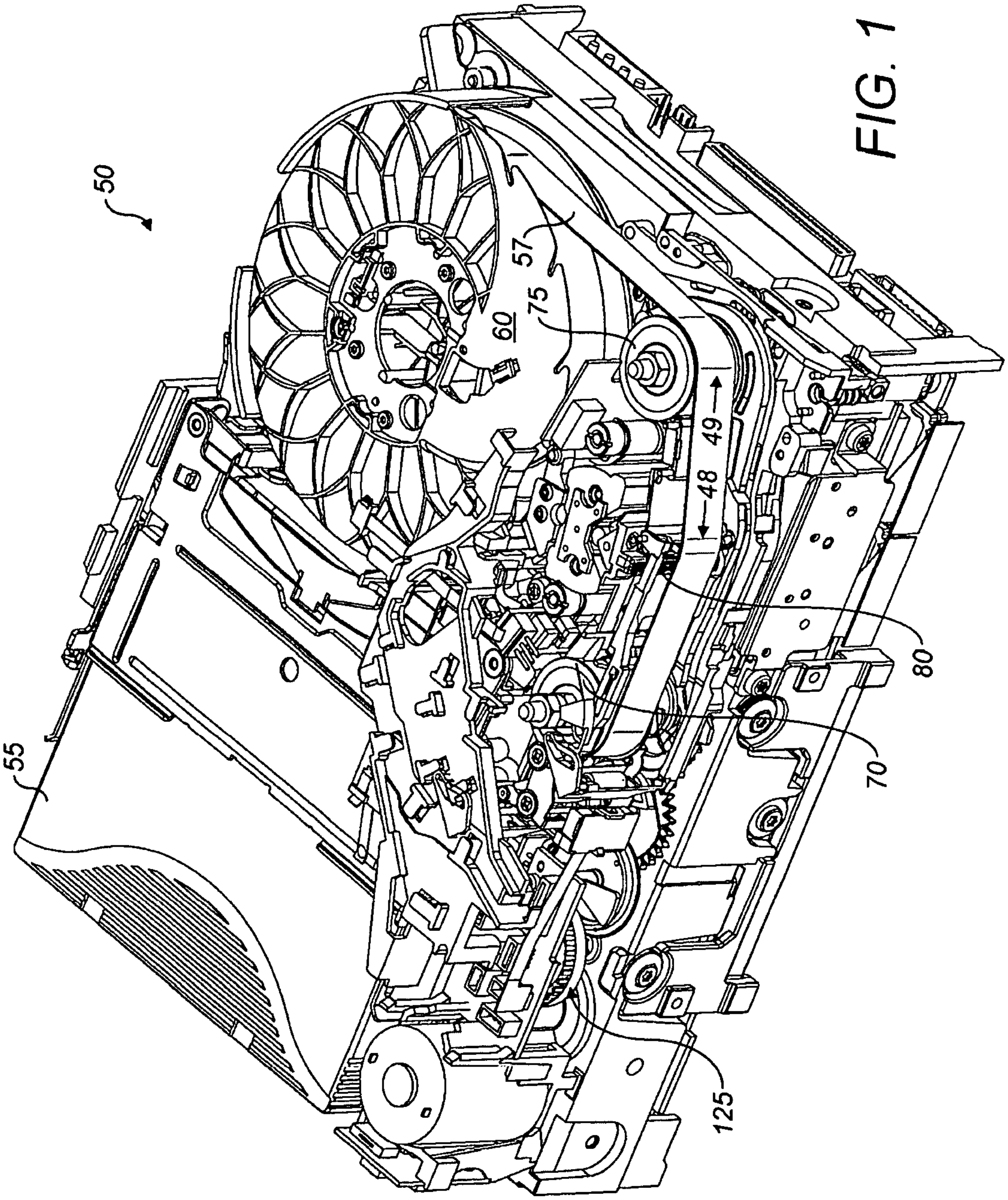


FIG. 1

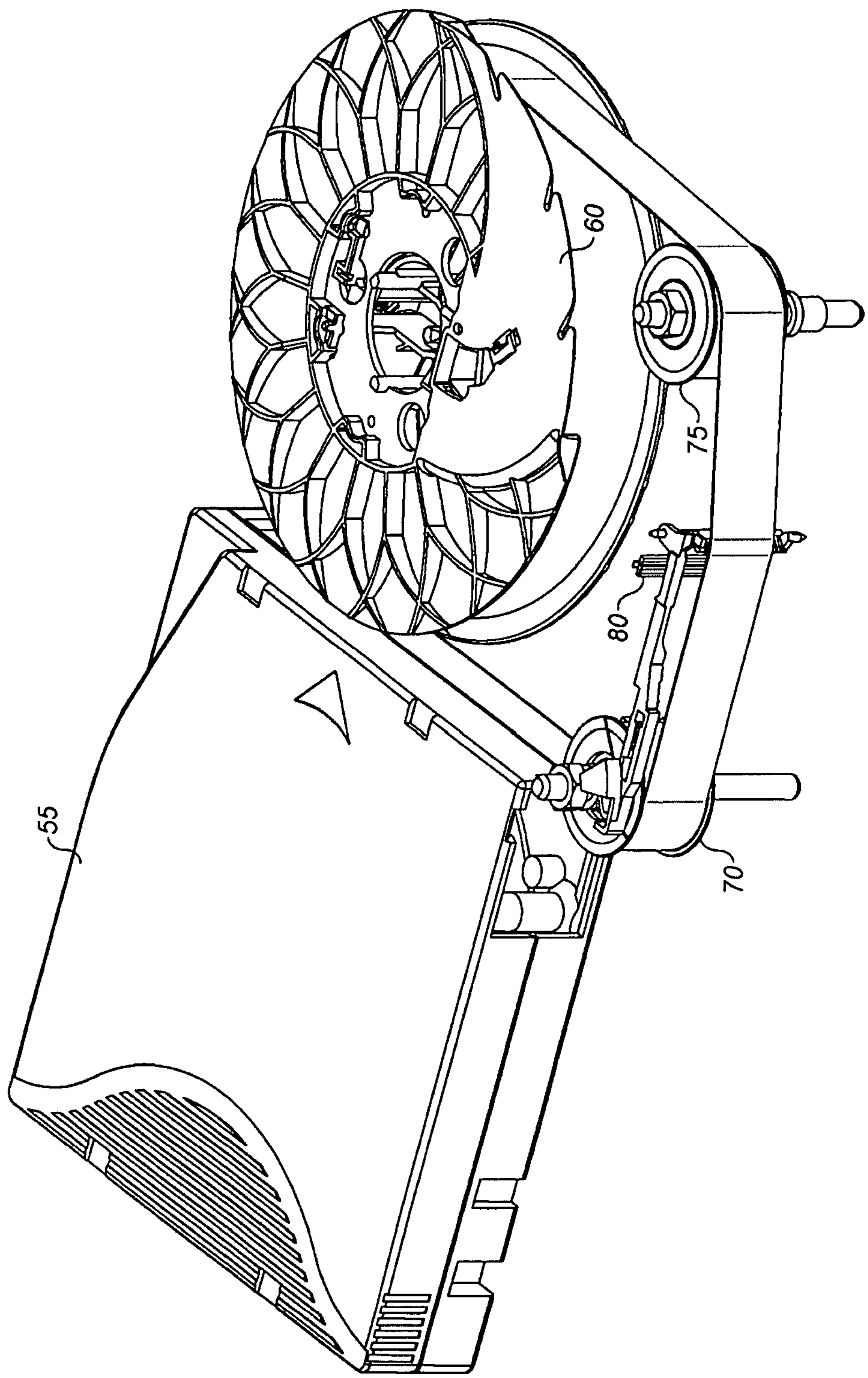


FIG. 2

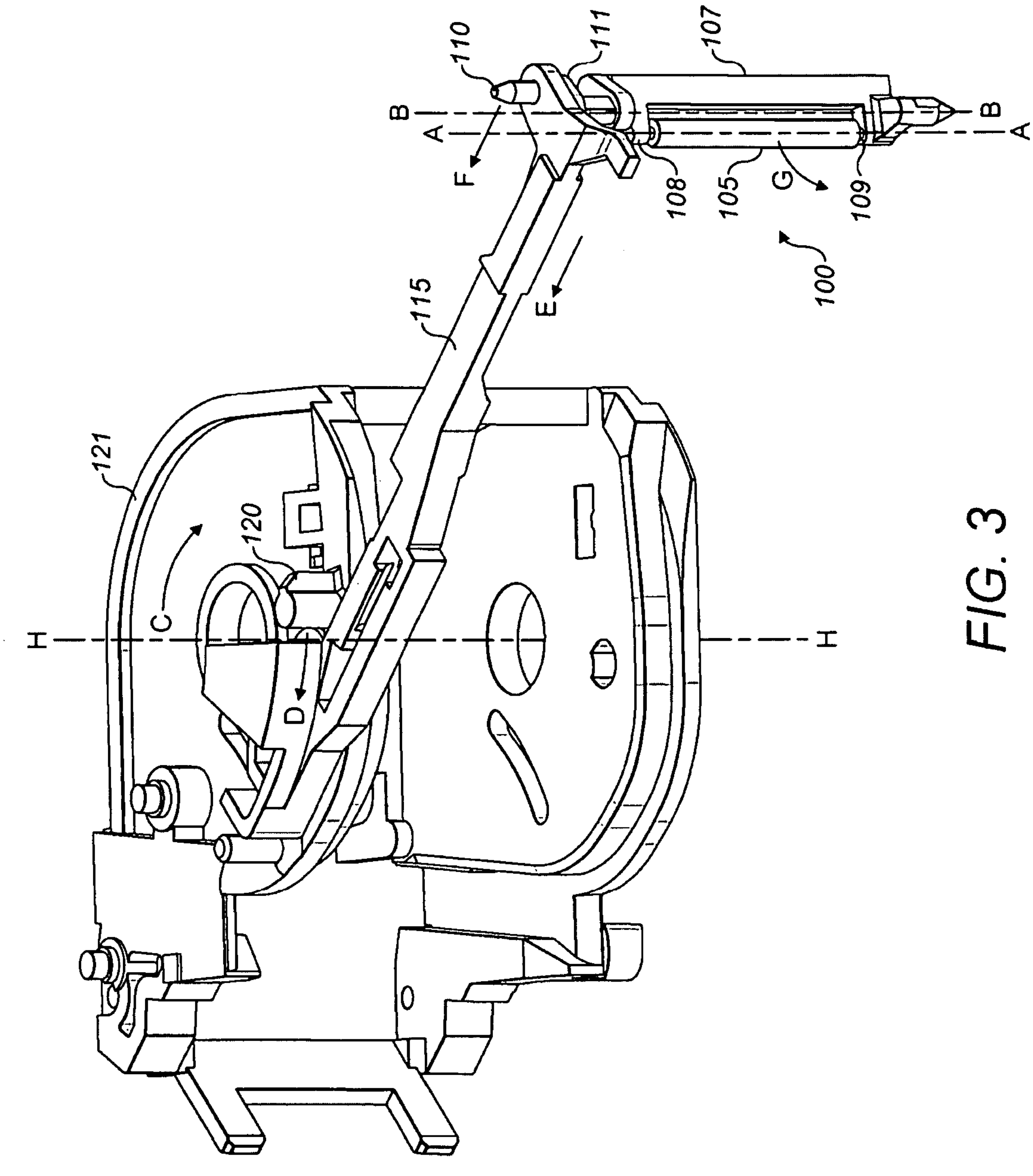


FIG. 3

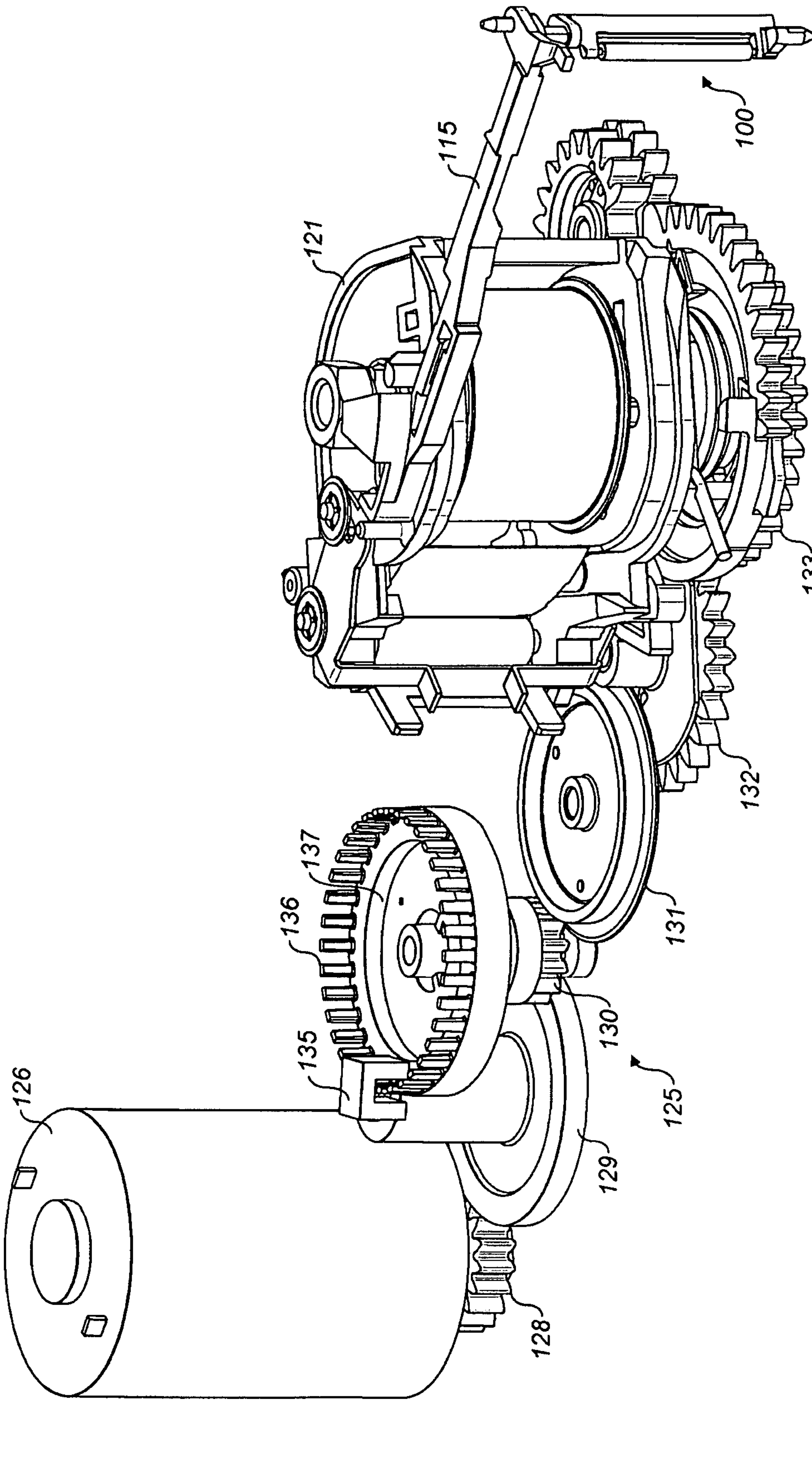


FIG. 4

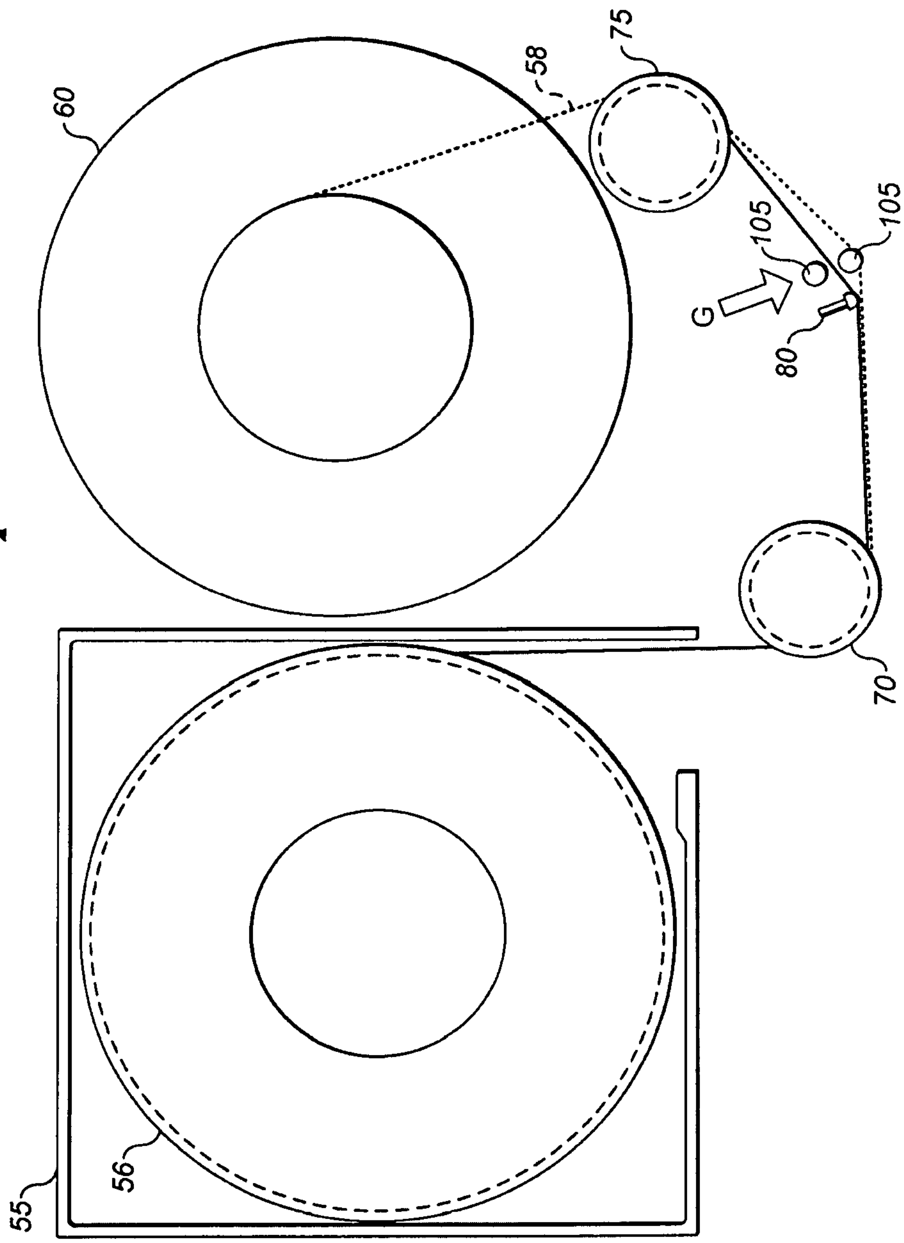


FIG. 5

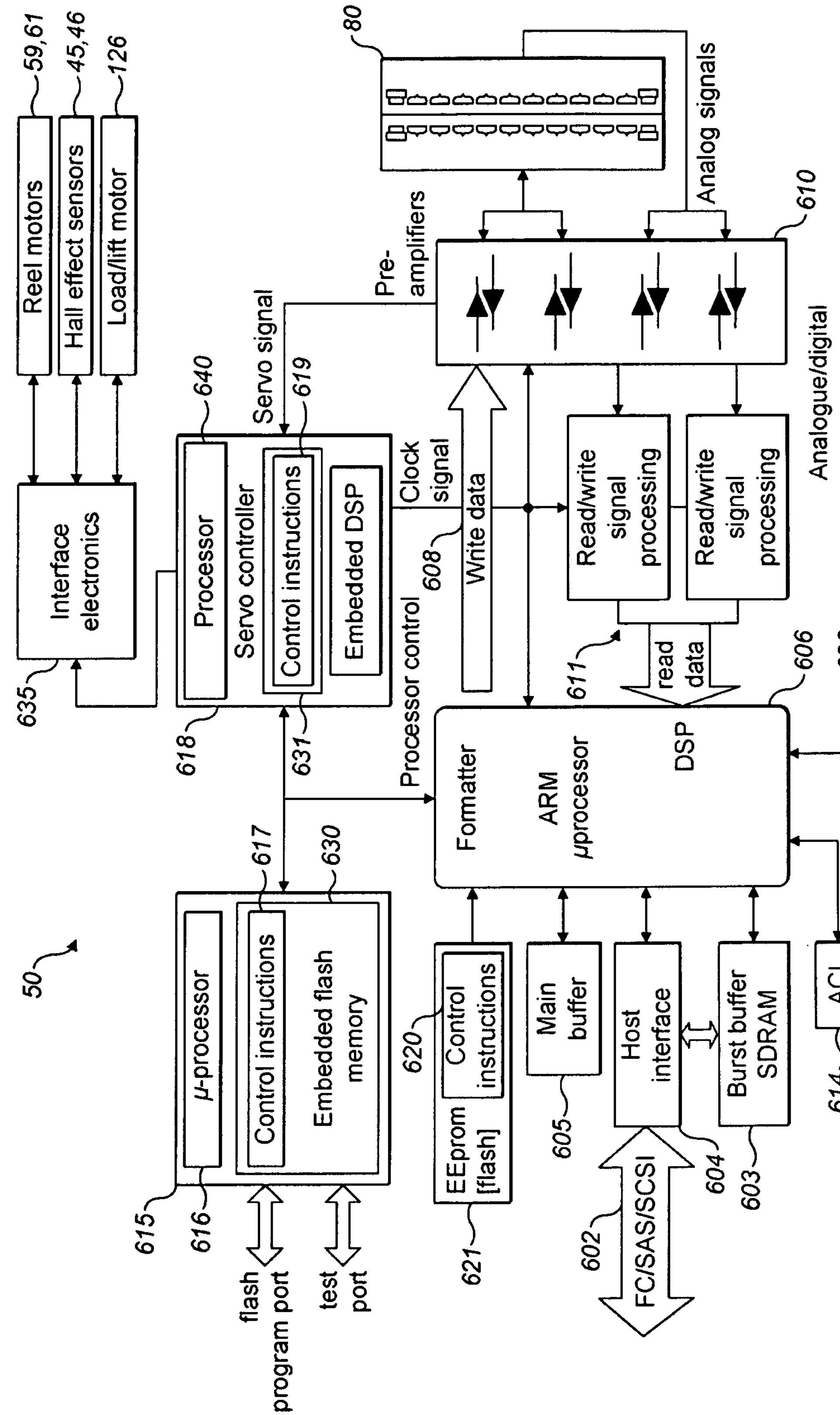

59,61
45,46
126
Reel motors
Hall effect sensors
Load/lift motor
80
Analog signals
Pre-
amplifiers
610
Servo signal
640
619
Interface
electronics
Processor
Servo controller
Control instructions
Embedded DSP
Clock
signal
Write data
608
Read/write
signal
processing
Read/write
signal
processing
Analogue/digital
635
618
631
Processor control
611
read
data
606
636
Formatter
ARM
μprocessor
DSP
User interface
50
617
630
μ-processor
Control instructions
Embedded flash
memory
620
Control
instructions
EEprom
[flash]
Main
buffer
Host
interface
Burst buffer
SDRAM
ACI
614
605
604
603
602
FC/SAS/SCSI
621
615
616
flash
program port
test
port

FIG. 6

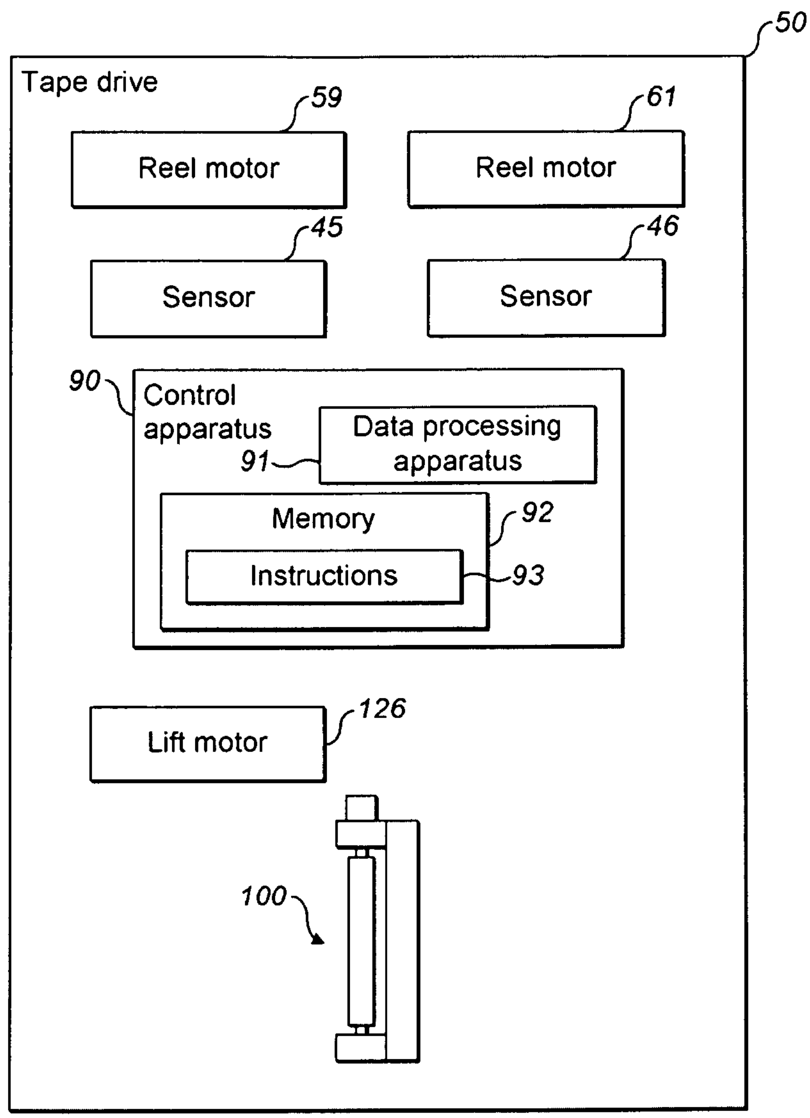

50
Tape drive
59
Reel motor
61
Reel motor
45
Sensor
46
Sensor
90
Control apparatus
Data processing apparatus
91
Memory
92
Instructions
93
Lift motor
126
100

FIG. 7

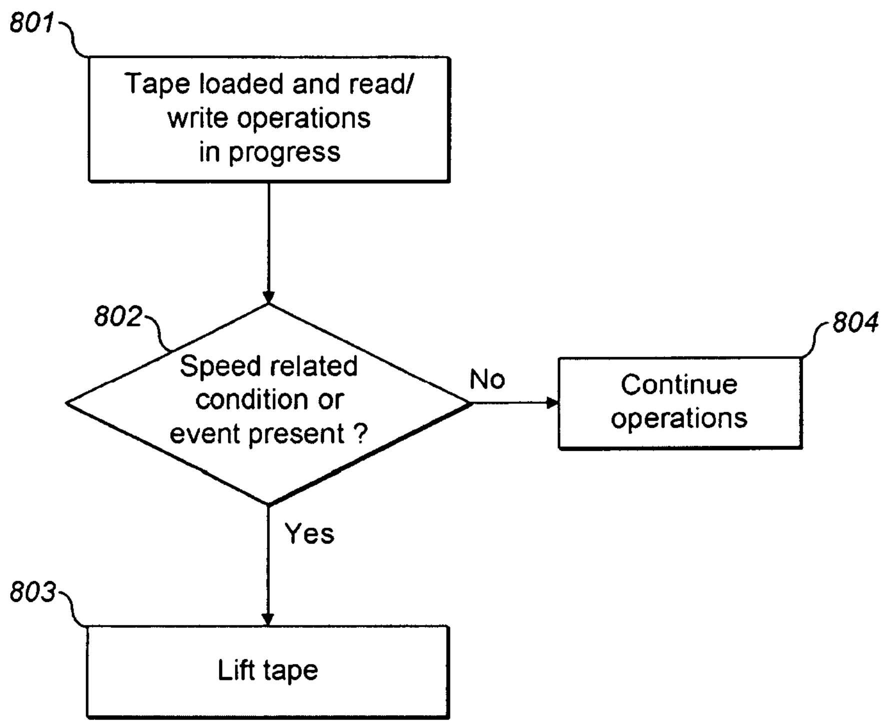

801
Tape loaded and read/ write operations in progress
802
Speed related condition or event present ?
No
Continue operations
804
Yes
803
Lift tape

FIG. 8

DATA TRANSFER APPARATUS

BACKGROUND

Data can be recorded on, and read from, a moving tape with a transducer (read and/or write) head which is positioned next to the tape. The tape is typically made up of a thin plastic base material with a coating of particles that that can be magnetized by a nearby magnetic field which aligns the magnetic domains of the particles. Once the field is removed, the particles remain aligned. For example, these particles may include ferric oxide, chromium oxide, metal films, and other suitable materials. Additionally, a number of coatings or additives can be added to the tape. By way of example and not limitation, the tape may include a binder matrix to attach the particles to the plastic base and lubricant to reduce friction and wear as the tape moves across surfaces of the transducer head.

The transducer head may have a single transducer (read and/or write) element or, as is more common, a series of transducer elements arranged within the head. Data is recorded in tracks on the tape by moving the tape, in a direction of a longitudinal axis of the tape, past the head. The transducer elements are typically very small electromagnets which are selectively activated by electrical signals which represent the data to be recorded on the tape. These electrical signals are transformed by the transducer elements into a concentrated magnetic field which aligns the magnetic domains of particles attached to the presently adjacent portion of tape. These particles remain magnetized with aligned magnetic domains, allowing the data written to the tape to be retrieved.

After the data is written to the tape, the data can be retrieved from the tape by again passing the tape over the head. The magnetic fields retained by the particles generate electrical impulses within the nearby transducer elements. These electrical impulses are filtered and amplified to produce a representation of the stored data.

As recording density increases in tape data transfer devices, surfaces of the tape and transducer heads have been made smoother to increase head/tape contact during data transfer (read and/or write) operations. The smoother surfaces can result in higher stiction forces. When the tape is well used, it tends to become even smoother, and its lubrication layer can be compromised, potentially further contributing to stiction.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be well understood, various embodiments thereof will now be described, by way of example only, with reference to the accompanying drawings, in which:

FIG. **1** is a perspective view from the top, rear and one side, showing portions of an exemplary tape drive;

FIG. **2** is a view similar to FIG. **1**, with certain features removed to better illustrate relative dispositions of a tape lifter, a transducer head, and a tape received in the tape drive;

FIG. **3** shows an actuator mechanism, for actuating the tape lifter, in greater detail;

FIG. **4** shows a drive train for the actuator mechanism in greater detail;

FIG. **5** is a plan view schematically illustrating selected features of the tape drive, illustrating movement of the tape lifter and the tape away from the transducer head;

FIG. **6** is a functional block diagram showing an exemplary arrangement for controlling various functions of the tape drive;

FIG. **7** is a higher level functional block diagram showing selected aspects of the tape drive of FIG. **1**, including an exemplary control apparatus for controlling the tape lifter; and

FIG. **8** is a flow diagram illustrating a method of lifting the tape.

Throughout the drawings, identical reference numbers designate similar, but not necessarily identical, elements.

DETAILED DESCRIPTION

Referring to FIGS. **1** to **7**, data transfer apparatus is shown in the form of a tape drive **50**. A single reel data tape cartridge **55**, comprising a cartridge reel **56** (FIG. **5**) and a tape **57**, is received in the tape drive **50**. The tape **57** is shown in FIGS. **1**, **2** and **5** in a deployed disposition, with a leading end portion of the tape taken up on a take-up reel **60** of the drive **50**. The tape drive **50** includes two guide rollers **70**, **75** for guiding the tape **57** along a tape path **58**.

Drive apparatus is provided in the form of a cartridge reel motor **59** (FIG. **7**) and a take-up reel motor **61** (FIG. **7**) for respectively driving the cartridge and take-up reels **56** and **60**. The cartridge and reel motors **59**, **61** can be controlled by control apparatus **90** (FIG. **7**) to move the tape **57** in a desired direction of a longitudinal axis of the tape **57**, as indicated by arrows **48** and **49** in FIG. **1**.

As illustrated in FIG. **7** and described in further detail below, the control apparatus **90** comprises data processing apparatus **91** including at least one processor, and a processor-readable medium in the form of memory apparatus **92**. The memory apparatus **92** comprises at least one non-volatile memory, for example in the form of an EEPROM, containing processor-readable program instructions **93** for processing by the processing apparatus **91**. The instructions **93**, when executed by the processing apparatus **91**, cause the processing apparatus **91** to perform various functions required of the control apparatus **90**, some of which are described in further detail below. Any convenient form or combination of volatile and/or non-volatile memories can be employed to contain the instructions **93**.

The tape drive **50** further includes a cartridge reel sensor **45** and a take-up reel sensor **46** (FIG. **7**). Signals from the sensors **45**, **46** can be used by the control apparatus **90** to obtain an indication of the speed of rotation of the cartridge and take-up reels **56**, **60**. In the present embodiment, for example, the reel motors **59**, **61** have sensors **45**, **46** in the form of respective integral Hall effect sensors that sense motor rotation. A Hall effect sensor is a transducer which varies its voltage output in response to changes in magnetic field. These changes in magnetic field can be generated by solid-state magnets integrated into the reel drive motors **59**, **61**. Alternatively, the Hall effect sensors could sense the commutation of coils within the reel drive motors, or another convenient form of sensor could be provided. Using the output of sensors **45**, **46**, the control apparatus **90** can determine and control tape speed.

A transducer head **80** is located on the tape path **58** between the guide rollers **70**, **75**. The transducer head **80** comprises first and second mutually spaced parallel arrays of transducer elements, the transducer elements being spaced along the longitudinal (vertically disposed in the orientation shown in FIGS. **1** and **2**) axis of the transducer head **80**, for transferring data to and from respective parallel data tracks (not shown) aligned along a direction of the longitudinal axis of the tape **57**. The transducer head **80** is connected to a read channel for converting transduced signals into digital data for processing by the drive, and to a write channel for supplying digital data for transducing onto tape.

The transducer head **80** also comprises further transducer elements for reading servo data from servo tracks (not shown) on the tape **57**. The transducer head **80** is further connected to a servo system to process servo data to provide the control apparatus **90** with tape position and speed data, for finer granularity of tape speed control, in a known manner.

As best seen in FIGS. **1**, **2** and **5**, the guide rollers **70**, **75** and the transducer head **80** are relatively disposed such that tape **57** moving along the portion of the tape path between the rollers **70**, **75** directly in front of the head **80**, is biased into contact with the transducer head **80** under the tension exerted on the tape **57** by the drive reels **56**, **60**, causing surface to surface contact between the transducer head **80** and the tape **57** in the contact region of the transducer head **80** and the tape path **58** during data transfer.

Adjacent the tape path **58**, at a location spaced along the tape path from the contact region of the transducer head **80** and the tape path **58** in the direction of the take-up reel **60**, there is provided a tape lifter **100**. The tape lifter **100** comprises a rolling contact member **105** that extends laterally of the contact surface of the tape **57** along a substantially upright axis A-A, and is rotatable about the axis A-A for rolling contact with tape **57** moving along the tape path **58**. The tape lifter **100** further comprises a support **107** mounted for rotation relative to the tape drive chassis about an axis B-B. The support **107** further comprises support arm portions **108**, **109** that support the contact member **105** for rotation about axis A-A. The support **107** further comprises an actuator portion **110** that is offset from the axis B-B by virtue of being mounted to the support **107** by a lever portion **111**.

The tape drive **50** also comprises an actuator arm **115** engaged at one end portion thereof (the right-hand end portion in the orientation of FIG. **3**) with the actuator portion **110** of the tape lifter support **107**, and engagable at an opposite end portion thereof (the left-hand end portion in the orientation of FIG. **3**) with a lug **120** fixed for rotation with a driven member **121**. The driven member **121** is connected to a drive train **125**, best shown in FIG. **4**, for being rotatably driven about an axis H-H. The drive train **125** comprises an electrical motor, shown as lift motor **126**, controllable by the control apparatus **90**, to drive a gear train **127** including gear members **128**, **129**, **130**, **131**, **132**, **133**.

With reference to FIG. **3**, rotation of gear member **133** in the direction of arrow C causes rotation of the driven member **121**, thereby causing the lug **120** to move in the general direction of arrow D and into contact with a surface (not shown) of the left-hand end portion of the actuator arm **115**. Continued rotation of the driven member **121** causes displacement of the actuator arm **115** in a direction generally along a longitudinal axis of the actuator arm **115** indicated by arrow E. Displacement of the actuator arm **115** causes the actuator portion **110** of the lifter support **107** to follow in a direction indicated generally by arrow F, causing the tape lifter **100** to pivot about the axis B-B. Pivoting of the tape lifter **100** about the axis B-B causes the rolling contact member **105** to move generally in a direction towards the tape path **58**.

Conveniently, actuation of the tape lifter **100** employs components that have other functions in the tape drive **50**, to minimise additional cost and footprint of the tape lifter at **100** and its actuation mechanism. For example, drive train **125** has primary functions including loading a tape cartridge **55** into the tape drive **50**, and actuating a tape threading mechanism. To effect a threading of a tape **57**, driven member **121** guides a receptacle block to receive a pin attached to a front end of the tape **57** in cartridge **55**, the receptacle block being disposed at one end of a leader tape, an opposite end of the leader tape being attached to the take-up reel **60**. During winding through of the leader tape and receptacle block by the take-up reel **60**, it is known to actuate a prior art tape lifter, bringing a cam surface of the prior art tape lifter into contact with the tape **57**, to hold the leader tape and receptacle block away from the transducer head **80**. Lifting the tape **57** away from the transducer head **80** during threading of the tape **57** prevents unnecessary wear and contamination of the transducer head **80**. After the tape **57** is threaded and positioned, the prior art tape lifter retracts, allowing the tape **57** to contact the transducer head **80**. It will be noted that these primary functions are not performed during data transfer operations.

FIG. **6** is a functional block diagram, showing an exemplary arrangement for controlling various functions of the tape drive **50**, including more detail of how the control apparatus **90** may be constituted. A host interface **604** is provided for connecting the tape drive **50** to a host computer (not shown) using, for example, Fiber Channel (FC), Serial Attached SCSI (SAS), SCSI, or any other suitable protocol **602**. Data received from one or more host computers through the interface **604** is processed and formatted by a formatter **606** into suitably formatted code words that are transferred through an internal communications medium **608** to a bank of pre-amplifiers **610** that provide analog signals to the transducer elements of the transducer head **80**. The formatter **606** comprises a processor. Program instructions **620** for controlling the formatter **606** processor can be provided in a memory **621**. The formatter **606** also has digital signal processing capability. Analog signals read by transducer elements from the tape are passed back through the pre-amplifiers **610**, converted into digital signals using processing capability **611**, and re-formatted by the formatter **606** for transmission through the interface **604** to a host computer. Buffers **603** and **605** are provided to facilitate management of data flows by the host interface **604** and formatter **606** respectively. An automation control interface **614** can be provided to enable operation of the drive in a tape library.

A system controller **615** (forming part of the control apparatus **90** of FIG. **7**) provides overall control of various functions of the tape drive **50**, including functions provided by the host interface **604**, the formatter **606** and a servo controller **618**. System controller **615** includes control program instructions **617** (forming part of program instructions **93**) stored in non-volatile memory **630** (forming part of memory apparatus **92**) supplying instructions to a system processor **616** (forming part of processing apparatus **91**).

The control apparatus **90** also includes the servo controller **618**, which comprises a processor **640** (forming part of processing apparatus **91**) supplied with program instructions **619** (forming part of program instructions **93**) stored in non-volatile memory **631** (forming part of memory apparatus **92**), for example EEPROM flash memory. The servo controller **618** receives and processes servo signals through the pre-amplifiers **610** from servo transducer elements on the transducer head **80**, for control of head **80** lateral position and finer grain control of tape speed, when the transducer head **80** is in contact with a tape **57**. The servo controller **618** under control of the program instructions **619**, and using suitable interfaces **635**, can also deterministically control tape drive functions such as transducer head **80** lateral positioning, reel motor **59**, **61** speed, cartridge **55** loading and unloading, and tape lifter actuation.

Operation of the tape lifter **100** will now be described. With reference to FIG. **8**, during data transfer operations **801**, for example with the tape drive **50** connected to a host computer, for storing data to tape from, or retrieving data from the tape for, the host computer, the tape **57** is lifted **803** relative to the transducer head **80** dependent on whether a tape speed related condition or event is present **802**. If the speed related condition or event is not present, operations continue normally, step **804**.

In the present embodiment, program instructions **617** (FIG. **6**) cause the system controller **615** to process data from the sensors **45**, **46** and repeatedly make a determination, taking into account the instant tape pack size on each reel **56**, **60**, whether tape speed has dropped below a predetermined speed threshold. In one embodiment, a minimum desirable operating speed of the tape drive **50** is 2 m/s, and it is desirable to mitigate or prevent surface to surface contact between the tape **57** and the transducer head **80** at tape speeds below about 0.25 m/s, and to effect surface to surface contact between the tape **57** and the transducer head **80** at tape speeds above about 0.75 m/s. Thus, the upper predetermined speed is set to 0.75 m/s. If the system controller **615** determines that tape speed is dropping and has moved below 0.75 m/s, the system control program instructions **617** cause the system controller **615** to instruct the servo controller **618** to control the lift motor **126** to initiate movement of the rolling contact member **105** of the tape lifter **100** towards the tape **57**. This approach allows latency of 0.5 ms to complete movement of the tape lifter **100** into its actuated position. If no such determination is made, normal data transfer operations continue without interruption.

With the tape lifter in an actuated condition, program instructions **93** are executed by the processing apparatus **91** to cause the control apparatus **90** to process data from the sensors **45**, **46** and repeatedly make a determination, whether tape speed has increased above a predetermined speed threshold. In one embodiment, the lower predetermined speed is 0.25 m/s. If the control apparatus **90** determines that tape speed is increasing and has moved above 0.25 m/s, the program instructions **93** cause the control apparatus **90** to control the lift motor **126** to move the tape lifter **100** back to its unactuated position and away from the tape **57** within the 0.5 m/s latency period. If no such determination is made, the tape lifter **100** remains in the actuated position.

In alternative embodiments, program instructions **617** do not cause the system controller **615** to make a speed determination. Instead, relative movement of the lifter **100** and tape **57** is initiated responsive to an alternative tape speed related event or condition. For example, a relevant event or condition could be associated with reaching an end of wrap, a detection of a bad write or a read error, or when there is insufficient host data to maintain a minimum tape speed necessary for data transfer operations, or any other condition or event related to tape speed, that indicates tape speed is decreasing to zero. The system controller **615**, in response to receiving information that such a condition is present or event has occurred, or in response to the generation of operational instructions related to such an event or condition, instructs the servo controller **618** to control the lift motor **126** to initiate movement of the rolling contact member **105** of the tape lifter **100** towards the tape **57**.

In further alternative embodiments, control of tape lift may be effected directly by a mechanical lift control mechanism (not shown) that is directly linked to a tape speed responsive mechanical component, such as a rotating part of a reel motor **59**, **61**, such that as tape speed drops towards zero, the tape speed responsive component acting directly on the lift control mechanism causes the transducer head **80** and tape **57** to move out of contact in response to a predetermined speed condition or event.

In the present embodiment, in response to initiation of the tape lifter **100**, the rolling contact member **105** moves in a direction having a component directed substantially orthogonally of the tape path **58**, biasing the tape **57** away from surface to surface contact with the transducer head **80**. In one embodiment, the control apparatus **90** receives information from a rotation detect sensor **135**, and drives the lift motor **126** until the rotation detect sensor **135** has detected movement past the sensor **135** of a predetermined number of teeth **136** of a rotation detect member **137** drivingly coupled to the gear train **128** to **133**. As illustrated in FIG. **5**, in which the amount of deviation of the tape path from a straight line between the guides **70** and **75** is much exaggerated, the motor **126** is controlled to move the contact member **105** with an orthogonal component of movement generally in the direction of arrow G, thereby lifting the tape **57** from the direction of one side of the contact region. The predetermined number of teeth **136** is selected to cause the motor **126** to drive the tape lifter **100** until the tape **57** is out of surface to surface contact with the transducer head **80**.

In alternative embodiments, contact between the tape **57** and transducer head **80** may only be reduced, and not completely eliminated. For example, the tape **57** may be lifted across a sub-region of the region of contact between the tape **57** and transducer head **80**, such as a region on one side of the transducer head **80**. In other embodiments, instead of the rotation detect sensor **135** and member **137**, an alternative approach is used to effect the desired range of movement of the contact member **105**. For example, the motor **126** could be driven for a predetermined time, and/or a position sensor could be used to identify an instant position of the contact member **105**.

The tape drive **50** operating as described in the immediately preceding paragraphs facilitates the mitigation or elimination of contact between the transducer head **80** and a tape **57** in response to tape speed dropping below a normal speed for data transfer operations and approaching zero. This facilitates the mitigation or elimination of adverse stiction events during low or zero tape speed events that routinely occur during data transfer operations, for example tape direction changes due to end of wrap, detection of a bad write, or a read error, or when there is insufficient host data to maintain a minimum necessary tape speed.

The tape lifter geometries and actuation described above are only illustrative embodiments of a tape lifter. In alternative embodiments, the tape lifter may have a variety of geometries, actuation, and methods for lifting the tape. For example, the tape lifter may contact the tape in two locations, one on either side of the head. In an alternative embodiment, the tape lifter may not move towards the tape **57**, but be brought into contact with the tape **57** when the transducer head **80** is retracted, by virtue of movement of the transducer head **80** away from the tape path **58**. In this manner, by retracting the head **80**, the tape **57** is supported by the tape lifter and the surface of the transducer head **80** is disengaged from the tape **57**. The tape lifter may be made from a variety of materials, including metal, plastic, composite, glass, or a combination of suitable materials. In further alternative embodiments, the contact member **105** of the tape lifter **100** may be fixed relative to the lifter support **107**, and not provide rolling contact.

The functions of the control apparatus **90**, in the present embodiment, are provided primarily by the system controller **616** and the servo controller **618**. However, any other convenient arrangement and/or combination of processing resources and program instructions could alternatively be employed to provide the control apparatus **90**.

The term processing apparatus can include microprocessors, microcontrollers, processor modules or subsystems (including one or more microprocessors or microcontrollers), or other control or computing devices. A "processor" can refer to a single component or to plural components. The term processor-readable medium can include one memory or a combination of memories. The memories can use any convenient technology, for example non-volatile memory technology including erasable and programmable read-only memories (EPROMs), electrically erasable and programmable read-only memories (EEPROMs) and flash memories. Alternative possibilities include semiconductor memory devices such as dynamic or static random access memories (DRAMs or SRAMs), and also magnetic disks and other magnetic and/or optical media.

In alternative embodiments the tape drive **50** could receive a two-reel cartridge and/or be provided with rotating heads. Furthermore, alternative tape speed control apparatus could be provided. For example, tape speed control could be effected by a capstan disposed along the tape path, with the reel motors providing appropriate tape tension, and/or no servo arrangement may be provided.

In the preceding description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the present systems and methods. It will be apparent, however, to one skilled in the art that the present apparatus, systems and methods may be practiced without these specific details. Reference in the specification to "an embodiment," "an example" or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment or example is included in at least that one embodiment, but not necessarily in other embodiments. The various instances of the phrase "in one embodiment" or similar phrases in various places in the specification are not necessarily all referring to the same embodiment.

The preceding description has been presented only to illustrate and describe embodiments and examples of the principles described. This description is not intended to be exhaustive or to limit these principles to any precise form disclosed. Many modifications and variations are possible in light of the above teaching.

What is claimed is:

1. Data transfer apparatus comprising:

drive apparatus to move a received tape along a path in a longitudinal direction of the tape;

a transducer head to transfer data to and/or from the tape;

a tape lifter to contact the tape; and

control apparatus operable, in response to a tape speed related condition or event, to cause relative movement between the tape lifter and the tape into mutual contact such that the tape lifter moves the tape, thereby biasing the tape away from surface to surface contact with the transducer head.

2. The data transfer apparatus of claim **1**, wherein the relative movement between the tape lifter and the tape lifts the tape out of any surface to surface contact with the transducer head.

3. The data transfer apparatus of claim **1**, wherein the tape lifter contacts the tape at a location on the tape path that is spaced along the tape path from a contact region of the transducer head and tape path, thereby lifting the tape from one side of the contact region.

4. The data transfer apparatus of claim **3**, wherein the out of contact portion of the tape path comprises a sub-region of the contact region.

5. The data transfer apparatus of claim **1**, wherein the tape lifter comprises at least one rolling contact member, for rolling contact with the tape moving along the tape path.

6. The data transfer apparatus of claim **1**, wherein the control apparatus is responsive to a determination that tape speed has dropped to or below a predetermined speed, or in response to the generation of operational instructions to reduce tape speed to or below a predetermined speed.

7. The data transfer apparatus of claim **1**, wherein the control apparatus comprises a mechanism directly acted upon by a tape speed responsive mechanical component.

8. The data transfer apparatus of claim **1**, the control apparatus comprising data processing apparatus and a processor-readable medium bearing processor-readable instructions, wherein the instructions, when executed by data processing apparatus of a tape data transfer apparatus, cause the data processing apparatus to determine if tape speed has dropped to or below a predetermined speed and, in response to a determination that tape speed has dropped to or below a predetermined speed, cause the data processing apparatus to output a signal to initiate movement of a tape out of surface to surface contact with a tape transducer head.

9. The data transfer apparatus of claim **1**, wherein the relative movement between the tape lifter and the tape is effected by movement of the tape lifter.

10. The data transfer apparatus of claim **1**, wherein the transducer head is stationary and the tape lifter moves independent of the transducer head to move the tape away from the transducer head.

11. The data transfer apparatus of claim **1**, further comprising at least one sensor to determine the tape speed.

12. The data transfer apparatus of claim **11**, wherein the at least one sensor is a Hall effect sensor.

13. The data transfer apparatus of claim **1**, wherein if the controller apparatus determines that tape speed is dropping and has moved below a predetermined speed, the controller apparatus initiating movement of the tape lifter towards the tape.

14. The data transfer apparatus of claim **13**, wherein further comprising the controller apparatus operating with latency to complete movement of the tape lifter into an actuated position.

15. A processor-readable non-transitory medium bearing processor-readable instructions, wherein the instructions, when executed by data processing apparatus of a tape data transfer apparatus, cause the processor, in response to a tape speed related condition or event, to cause relative movement between the tape lifter and the tape into mutual contact such that the tape lifter moves the tape, thereby biasing the tape away from surface to surface contact with the transducer head.

16. The processor-readable medium of claim **15**, wherein the instructions, when executed by the processor, cause the data processing apparatus to determine if tape speed has dropped to or below a predetermined speed and, in response to a determination that tape speed has dropped to or below a predetermined speed, cause the data processing apparatus to output a signal to initiate movement of a tape lifter to lift a tape out of surface to surface contact with a tape transducer head.

17. A method of reducing stiction in a tape drive comprising a transducer head, the method comprising, responsive to a tape speed related condition or event, causing relative movement between the tape lifter and the tape into mutual contact such that the tape lifter moves the tape, thereby biasing the tape away from surface to surface contact with the transducer head.

18. The method of claim **17**, comprising determining if a speed of the tape has dropped to or below a predetermined speed, and in response to a determination that the tape speed has dropped to or below the predetermined speed, moving the tape lifter to lift the tape away from surface to surface contact with the transducer head.

19. The method of claim **17**, wherein the tape speed related condition or event comprises the generation of operational instructions to reduce tape speed to or below a predetermined speed.

20. The method of claim **17**, comprising lifting the tape away from surface to surface contact from a location along the tape path disposed to one side of a contact region of the transducer head and tape path, whereby the tape is lifted out of surface to surface contact with the transducer head only in a sub-region of the contact region.

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